Noise Load for Comprehensive Receiver Test

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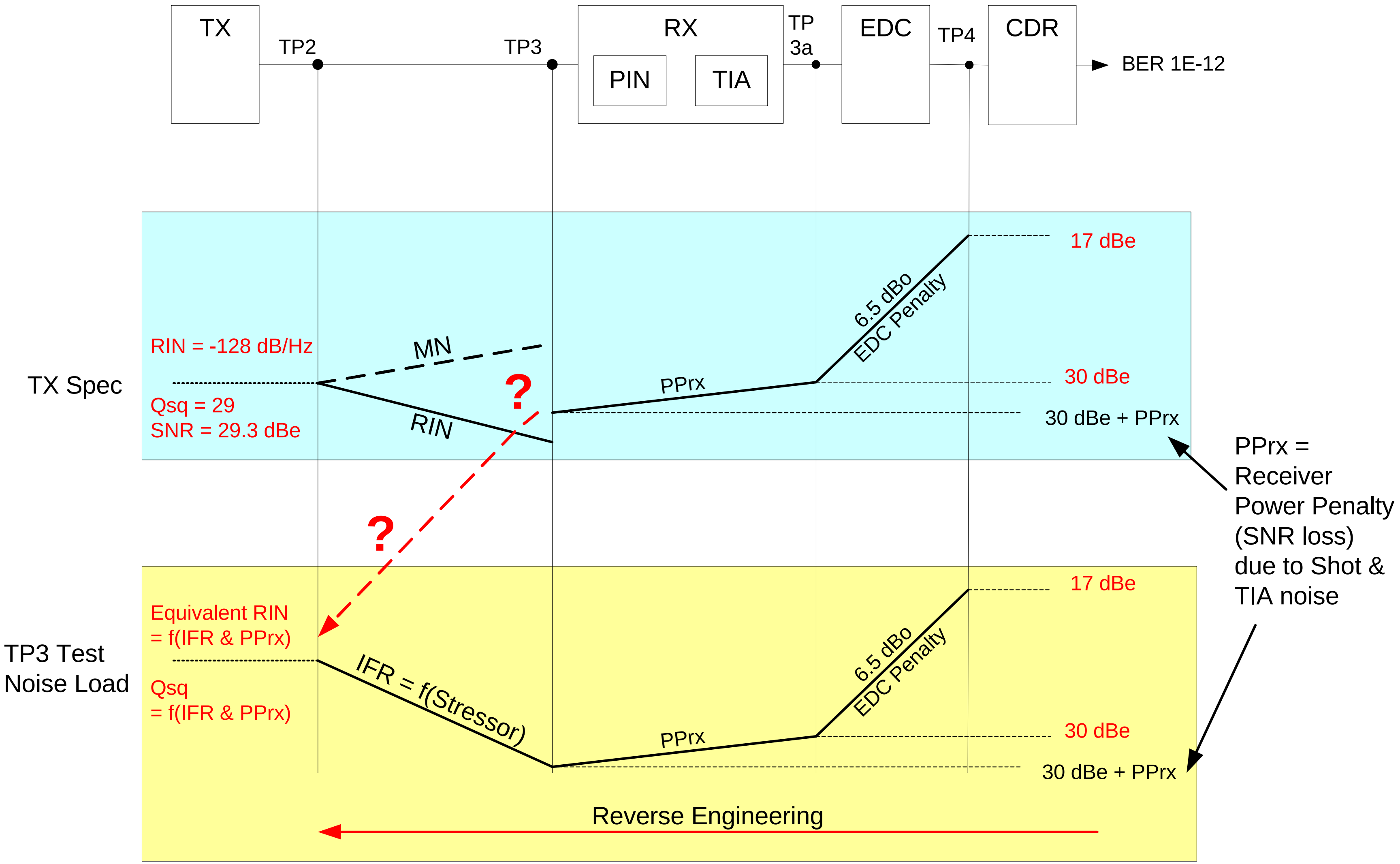
Link SNR



TX
TP2
TP3
RX
PIN
TIA
TP
3a
EDC
TP4
CDR
BER 1E-12
TX Spec
RIN = -128 dB/Hz
Qsq = 29
SNR = 29.3 dBe
MN
RIN
?
PPrx
6.5 dBo
EDC Penalty
17 dBe
30 dBe
30 dBe + PPrx
PPrx =
Receiver
Power Penalty
(SNR loss)
due to Shot &
TIA noise
?
TP3 Test
Noise Load
Equivalent RIN
= f(IFR & PPrx)
Qsq
= f(IFR & PPrx)
IFR = f(Stressor)
PPrx
6.5 dBo
EDC Penalty
17 dBe
30 dBe
30 dBe + PPrx
Reverse Engineering

Noise Load Calibration

- The required Q_{sq} for the noise calibration has to stress the EDC receiver in that way, that with an EDC margin of 6.5 dBo, the remaining SNR does not drop below 17 dBe in order to achieve a BER of at least 1E-12.
- The required Q_{sq} for the noise calibration is a function of IFR and Receiver SNR loss (PPrx)
- The required Q_{sq}, the IFR of the selected stressor, and the receiver SNR loss have to match the 30dBe SNR margin (see the calculations on the following pages)
- Any change of the RIN&MN penalty would change the link budget

Effective Receiver Noise

OMAsens = -14.1 dBm (38.9 μW) (1)
OMAr = - 6.5 dBm (224 μW) (2)

Receiver inferred noise power: $$PNrx(rms) = \frac{OMAsens}{2 \times Q} = \frac{38.9\mu W}{2 \times 7.03} = 2.76\mu W \quad (3)$$

Effective receiver noise power (colored noise load plus inferred receiver noise)
Is a function of Qsq and IFR:

$$PNeff = \sqrt{PNload^2 + PNrx^2} \quad (4)$$

$$= \sqrt{\left(\frac{224\mu W}{2 \times \frac{Qsq}{IFR}}\right)^2 + (2.76\mu W)^2} \quad (5)$$

Receiver SNR Loss

The effective receiver noise can be transformed into a receiver SNR loss (PPrx), which is the difference between the SNR due to noise load and the effective SNR (Q_{eff}).

$$\mathrm{PPrx} = 20 \times \log \frac{Q_{sq}}{IFR} - 20 \times \log Q_{eff} \tag{6}$$

$$= 20 \times \log \frac{Qsq}{IFR} - 20 \times \log \frac{224\mu W}{2 \times \sqrt{\left(\dfrac{224\mu W}{2 \times \dfrac{Qsq}{IFR}} \right)^2 + 2.76\mu W^2}} \tag{7}$$

Complete Receiver Test SNR

From Link Diagram:

$20 \log Q_{sq}$ = 17 dBe + 2x6.5 dBo + PPrx – IFR(dB) (8)

With (7):

$$20 \log Q_{sq} = 30 \text{ dBe} - 20 \log \text{IFR} + 20 \times \log \frac{Qsq}{IFR} - 20 \times \log \frac{224 \mu W}{2 \times \sqrt{\left(\frac{224 \mu W}{2 \times \frac{Qsq}{IFR}} \right)^2 + (2.76 \mu W)^2}}$$

Resolved for Q_{sq}:

$$Q_{sq} = \frac{IFR \times 224 \mu W}{2 \times \sqrt{\left(\frac{224 \mu W \times IFR^2}{2 \times 10^{1.5}} \right)^2 - (2.76 \mu W)^2}} \qquad (9)$$

Results with Stressor IFR

	Index	PIE-D	IFR [dBo]	IFR as used above	Q_{sq}	Equiv.RIN [dB/Hz]@7.5GHz
Pre	10	3.82	-2.734	1.876	17.28	-123.50
	23	4.57	-2.759	1.887	17.17	-123.44
	25	5.02	-3.797	2.397	13.31	-121.23
split	5	3.83	-1.729	1.489	22.68	-125.86
	22	4.57	-2.671	1.849	17.56	-123.64
	24	4.99	-3.176	2.078	15.47	-122.54
post	15	4.20	-3.349	2.162	14.83	-122.17
	20	4.56	-3.349	2.162	14.83	-122.17
	23	4.92	-3.219	2.098	15.31	-122.45